



The humble hard disk works diligently to meet all your storage needs and ensure your computer performs efficiently and quickly. We test some of the best internal disks designed to make your life easier

Hard Disks

A hard disk is not the most glamorous of computer products, but it is one of the most important components you'll ever buy. Most of us possess an ever-increasing collection of digital photos, videos and music files, all eating up our PC's available storage space. If you don't want to run into problems, it's a good idea to upgrade your disk before you run out of space completely, which is where this *Labs* can help.

If it's a while since you bought your last hard disk, you'll be amazed at how much storage space you can get for your money. These days £100 buys you no less than 250GB. In this round-up we look at six parallel ATA (PATA) and 12 serial ATA (SATA) drives. You're guaranteed to find something that can boost your computer's storage capacity – even if it is a few years old.

You'll also benefit from improved performance if you move your Windows installation to your new disk, perhaps by using Partition Manager 2005 on this month's cover disc: see *How To...* *Manage Disk Partitions* on page 211 for details.



CHOOSING A... HARD DISK

Desktop hard disks use two different types of interface: the older PATA and the newer SATA. The type you choose depends on which connectors you have available on your motherboard. Older systems may be limited to the more cumbersome, slightly slower PATA interface, but new systems should have a free SATA socket. Check your motherboard

manual to make sure. If you have only a PATA connection, you can buy a SATA interface card for a free PCI slot, but there's not much performance to be gained for the £20 outlay.

The most recent incarnation of PATA runs at a maximum speed of 133MB/s, while the first generation of SATA hits 150MB/s. In practice, the hard disks never reach these speeds. Think of it as equivalent to the motorway speed limit being raised to 300mph. You won't reach your destination any quicker if your car starts to fall apart at 100mph.

HARD UP

The PATA drives on test are all backwards-compatible. In other words, as long as your system has a physically similar PATA interface, you can install any of the PATA drives in this review. Some older systems have difficulty working with disks larger than 137GB. If your motherboard BIOS has this problem, you may need to install disk manager software, which is available from most disk manufacturers' websites. Those with PCs that run older versions of Windows may need to install service packs before their machines will support 137GB disks. You may even be forced to partition your disk. Seagate's white paper at www.seagate.com/support/kb/disc/tp/137gb.pdf discusses some feasible solutions.

Three of the SATA disks in our test are specified to the SATA II standard. SATA II is completely compatible with the original SATA. The interface has a theoretical throughput of 300MB/s but, again, real hard disks never reach this speed. More importantly, the SATA II specification includes native command

queuing (NCQ). This is available in a few drives as an optional SATA component, but with SATA II it comes as standard. NCQ rearranges disk accesses into the most efficient sequence. This has a minimal effect on file copying but can speed up disk access during multitasking operations.

STORE GAZING

The general rule in computing is that more is better. A higher-capacity disk will immediately give you more storage space and will help put off your next upgrade. However, there is a capacity beyond which disks become less cost-effective. At the moment, disks of around 250GB offer the lowest cost per gigabyte of storage. One money-saving route to higher capacities is to combine 250GB disks in a RAID 0 configuration so that they appear as a single high-performance volume. For details, see *How it Works*, *Shopper* July 2005.

PERFORMANCE ISSUES

Several factors determine how quickly your hard disk reads and writes data. The spindle speed, the density of data on the disk, the buffer size and the speed of head movement all play a part. There is no single specification that indicates a disk's overall speed.

Because hard disks are often designed to work well in synthetic benchmark tests, we used real-world file copy operations to test the performance of each drive. We measured read and write performance by copying files between a RAM disk and the hard disk on test. Our Large Files test consists of a single 100MB file; our Small Files test comprises several thousand files with a total size of 100MB. The test was repeated across the disk surface to calculate an average performance in megabytes per second. We also measured hard disk access times using the HD Tach test. All tests were carried out on the same 3.6GHz Pentium 4 test PC with 1GB of memory.



▲ Older PATA disks have a wide interface that connects to the motherboard using a ribbon cable



▲ As well as using neater cables, newer SATA hard disks offer speed improvements over PATA drives



SERIAL ATA INTERNAL HARD DISKS

MANUFACTURER	HITACHI	HITACHI	HITACHI	MAXTOR	MAXTOR	SAMSUNG
Model	Deskstar 7K80	Deskstar 7K250	Deskstar 7K500	DiamondMax 10	DiamondMax 10	SpinPoint SP1614C
Rating	★★★	★★★★	★★★★	★★★★	★★★	★★★
Pros	Inexpensive for a SATA II disk; above-average performance	Good value high-capacity disk with fine performance with small files	The largest hard disk available; impressive small-file transfer speeds	Lowest cost per gigabyte of all the SATA drives; good large-file transfer speeds	High-capacity, reasonably priced disk with very fast data reading rates	Reasonable all-round performance
Cons	High cost per gigabyte	Performance with large files is less impressive	Two 250GB disks are much better value	Struggles in the Small File writing test	Struggles in the Small File writing test	Slightly more expensive than other 160GB drives
STORAGE						
Capacity	80GB	250GB	500GB	200GB	300GB	160GB
Formatted capacity (NTFS)	77GB	229GB	466GB	190GB	279GB	149GB
Price per gigabyte	56p	37p	59p	36p	41p	43p
Interface	SATA II 300	SATA 150	SATA II 300	SATA 150	SATA 150	SATA 150
Power connector	SATA, ATX	SATA, ATX	SATA, ATX	SATA	SATA	SATA
Spindle speed	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm
Cache	8MB	8MB	16MB	8MB	16MB	8MB
Quoted seek time	8.8ms	8.5ms	8.5ms	9.0ms	9.0ms	8.9ms
HD Tach access time	12.8ms	11.9ms	13.0ms	15.8ms	15.5ms	14.0ms
Platters	1	3	5	3	3	2
Heads	2	6	10	6	6	4
NCQ	Yes	No	Yes	Yes	Yes	No
Bearing technology	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic
Noise level when idle	26dBA	30dBA	31dBA	29dBA	29dBA	27dBA
BUYING INFORMATION						
Price inc VAT	£45	£93	£297	£71	£123	£70
Supplier	www.cannings.co.uk	www.dabs.com	www.europc.co.uk	www.novatech.co.uk	www.komplett.co.uk	www.microdirect.co.uk
Warranty	Three years	Three years	Three years	Three years	Three years	Three years
Details	www.hitachigst.com	www.hitachigst.com	www.hitachigst.com	www.maxtor.com	www.maxtor.com	www.samsung.com
Part code	HDS728080PLA380	HDS722525VLSA80	HDS725050KLA360	6L200M0	6B300S0	SP1614C
						

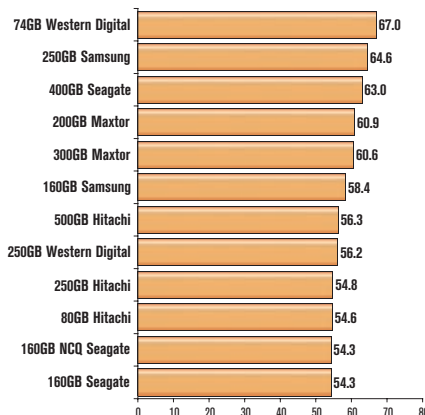
MANUFACTURER	SAMSUNG	SEAGATE	SEAGATE	SEAGATE	WESTERN DIGITAL	WESTERN DIGITAL
Model	SpinPoint SP2504C	Barracuda 7200.7	Barracuda 7200.7	Barracuda 7200.8	Caviar SE	Raptor
Rating	★★★★★	★★	★★★	★★★★	★★★	★★★★
Pros	Great performance across the board; one of the lowest costs per gigabyte	Inexpensive; comes with a five-year warranty	Inexpensive; comes with a five-year warranty	Good performance with large files; high capacity; five-year warranty	Very low cost per gigabyte	The fastest drive by some margin; five-year warranty
Cons	Marginally more expensive than other 250GB drives	Poor performance in all our file transfer tests	Poor performance in all our file transfer tests	Rather high cost per gigabyte	Worst performance for a SATA drive	Incredibly expensive compared to other desktop hard disks
STORAGE						
Capacity	250GB	160GB	160GB	400GB	250GB	74GB
Formatted capacity (NTFS)	232GB	127GB	127GB	362GB	232GB	69GB
Price per gigabyte	38p	40p	41p	46p	37p	168p
Interface	SATA II 300	SATA 150	SATA 150	SATA 150	SATA 150	SATA 150
Power connector	SATA	SATA	SATA	SATA	SATA, ATX	SATA, ATX
Spindle speed	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm	10,000rpm
Cache	8MB	8MB	8MB	8MB	8MB	8MB
Quoted seek time	8.9ms	8.5ms	8.5ms	8ms	8.9ms	4.5ms
HD Tach access time	14.7ms	12.6ms	12.7ms	15.5ms	13.0ms	7.7ms
Platters	2	2	2	4	3	2
Heads	4	4	4	8	6	4
NCQ	Yes	No	Yes	Yes	No	No
Bearing technology	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic
Noise level when idle	25dBA	25dBA	25dBA	28dBA	34dBA	32dBA
BUYING INFORMATION						
Price inc VAT	£96	£64	£66	£184	£94	£124
Supplier	www.komplett.co.uk	www.savastore.com	www.technoworld.com	www.savastore.com	www.dabs.com	www.dabs.com
Warranty	Three years	Five years	Five years	Five years	Three years	Five years
Details	www.samsung.com	www.seagate.com	www.seagate.com	www.seagate.com	www.wdc.com	www.wdc.com
Part code	SP2504C	ST3160023AS	ST3160827AS	ST3400832AS	WD2500JD-00HBC0	WD740GD-00FLA2
						



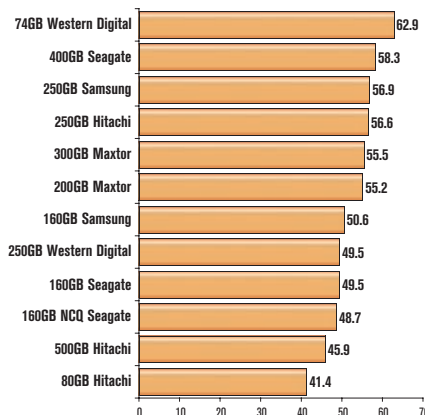
BENCHMARKS

Performance SATA Internal Hard Disks

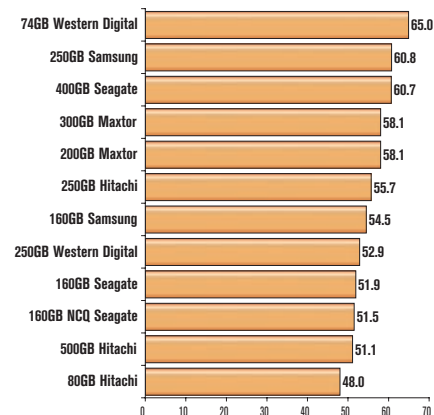
Read: Large Files (MB/s)



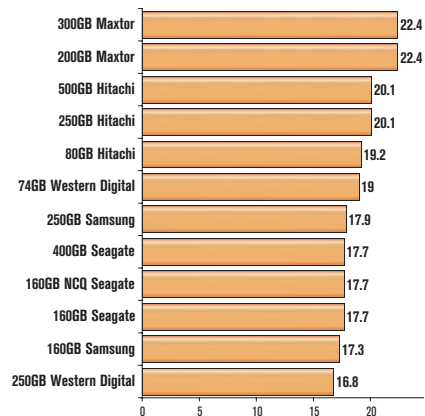
Write: Large Files (MB/s)



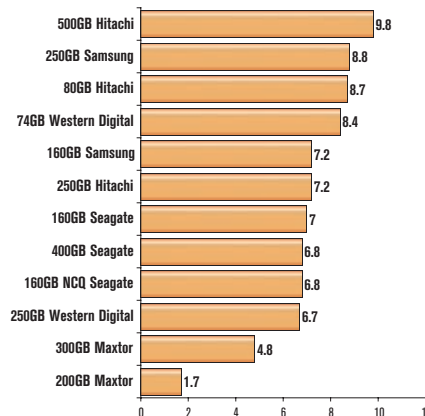
Large Files Overall (MB/s)



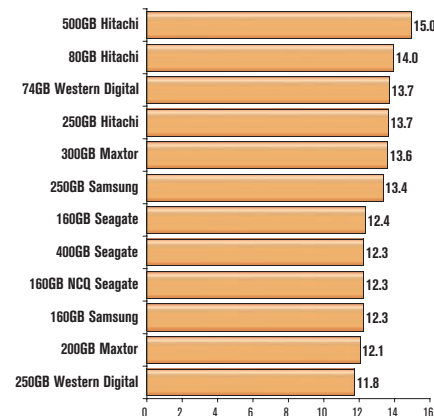
Read: Small Files (MB/s)



Write: Small Files (MB/s)



Small Files Overall (MB/s)



LABS VERDICT SATA HARD DISKS

All new desktop computers use the SATA interface to connect the hard disk to the rest of the PC. If you bought your computer in the past two years, it'll almost certainly use this interface. Some systems have both SATA and PATA interfaces. If your PC has both, go for a SATA disk. This interface has a slight performance edge over PATA, and you'll be able to transfer the disk to your next computer when the time comes.

The SATA disks in this test range in volume from 74GB for the performance-focused Western Digital Raptor to the enormous 500GB Hitachi Deskstar 7K500. All the drives have at least 8MB of cache memory and spin at 7,200rpm, with the exception of the Raptor, which whirrs at a heady 10,000rpm. Three drives – two Hitachis and one Samsung – have a SATA II interface, which is potentially faster than SATA and compatible with the earlier standard. As our performance graphs show, though, the faster interface has little impact on drive performance, as the disks are not fast enough to use the extra bandwidth.

If you're more interested in space than performance, concentrate on a drive's price per gigabyte; this is listed in the tables on page 169 and 171. There is a price/capacity optimum of

around 250GB for SATA hard disks, and drives that are above and below this size are less economical. Both the Hitachi Deskstar 7K250 and Western Digital Caviar SE 250GB offer impressively cheap storage at 37p per gigabyte. At the other end of the scale, the Western Digital Raptor costs a whopping 168p per gigabyte. Although it tops the table for its performance with large files thanks to a 10,000rpm spindle speed, it's not the fastest when working with small files so it's hard to justify the expense.

While both 250GB drives mentioned provide plenty of space for your money, the Best Buy must be the Samsung SpinPoint SP2504C. It's only slightly more expensive than the other 250GB drives and offers a SATA II interface with NCQ. It's also near the top of our performance tables.

The three 160GB SATA drives – the Seagate Barracuda 7200.7 ST3160023AS and NCQ-enabled ST3160827AS and Samsung SpinPoint SP1614C – didn't impress. All have a relatively high cost per gigabyte and offer lacklustre performance.

Hitachi's 7K80 has the lowest capacity of the SATA disks in this test, apart from the Western Digital Raptor. At £44, it's a cheap way to add storage. However, it costs 56p per gigabyte, so you won't get exceptional value or a very fast drive.

Both Maxtor drives struggled with small file transfers but steamed through the large files. The 200GB drive's poor performance in the small files tests may be due to its smaller buffer. Both offer a reasonable amount of storage for your money. The 200GB DiamondMax 10 6L200M0 is better value than the 300GB DiamondMax 10 6B300S0, but the latter performs better overall.

Of the large-capacity disks, Seagate's 400GB Barracuda 7200.8 ST3400832AS is a little slower than Hitachi's 500GB Deskstar 7K500, but at only £184 it is considerably cheaper per gigabyte. If you're looking for masses of storage, an ST3400832AS or two would be a sensible option.

SAMSUNG SpinPoint SP2504C





PARALLEL ATA INTERNAL HARD DISKS

MANUFACTURER	EXCELSTOR	HITACHI	MAXTOR	SAMSUNG	SEAGATE	WESTERN DIGITAL
Model	Jupiter 880 Callisto	Deskstar T7K250	DiamondMax Plus 9	SpinPoint P80	Barracuda 7200.8	Caviar SE
Rating	★★★★	★★★★	★★	★★★	★★★★	★★★★
Pros	One of the cheapest drives around; decent performance	The fastest PATA drive here; low price per gigabyte	Good read and write speeds for large files	The cheapest 160GB hard disk available	High-capacity storage for non-SATA systems; fine performance	Unbeatable value at 33p per gigabyte
Cons	Like all smaller drives it has a relatively high cost per gigabyte	Only £5 less than the 200GB Western Digital drive	Poor small-file write performance; fairly expensive for 200GB	In the bottom half of the performance tables	Two 200GB disks are cheaper, if you've got room	Poor file transfer rates in all our benchmarks
STORAGE						
Capacity	80GB	160GB	200GB	160GB	400GB	200GB
Formatted capacity (NTFS)	77GB	149GB	189GB	149GB	373GB	186GB
Price per gigabyte	47p	38p	40p	37p	46p	33p
Interface	ATA 133	ATA 133	ATA 133	ATA 133	ATA 133	ATA 133
Power connector	ATX	ATX	ATX	ATX	ATX	ATX
Spindle speed	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm	7,200rpm
Cache	2MB	8MB	8MB	2MB	8MB	8MB
Quoted seek time	8.5ms	8.5ms	9.3ms	8.9ms	8.0ms	8.9ms
HD Tach access time	12.8ms	12.7ms	16.9ms	13.6ms	15.5ms	13.1ms
Platters	1	2	3	2	3	3
Heads	2	3	6	4	6	6
Bearing technology	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic	Fluid dynamic
Noise level when idle	26dBA	28dBA	27dBA	27dBA	28dBA	28dBA
BUYING INFORMATION						
Price inc VAT	£38	£61	£79	£59	£185	£66
Supplier	www.misco.co.uk	www.komplett.co.uk	www.specialtech.co.uk	www.savastore.com	www.misco.co.uk	www.savastore.com
Warranty	Three years	Three years	Three years	Three years	Five years	Three years
Details	www.excelstor.com	www.hitachigst.com	www.maxtor.com	www.samsung.com	www.seagate.com	www.wdc.com
Part code	ESJ800-001	HDT722516DLAT80	6Y200P0	SP1604N	ST3400832A	WD2000JB

LABS VERDICT PATA HARD DISKS

The parallel ATA interface is being phased out as hard disk and motherboard manufacturers switch to the faster and tidier serial-ATA interface, but PATA drives are still widely available. If you are upgrading an older computer, you may be limited to using PATA. In the short term this isn't a problem, as PATA drives are virtually as fast as the current generation of SATA drives – but your next computer will probably provide PATA connectors only for optical drives, so you'll have to leave the drive behind eventually.

The current pricing on the Samsung SP1604 and Maxtor DiamondMax Plus 9 6Y200P0 is a little high considering their modest speed.

If cheap space is your only concern, the Western Digital 200GB Caviar SE is unbeatable. At just 33p per gigabyte of storage it is the most economical drive in our test, setting you back a reasonable £66. It performs poorly, though.

If you need a fast disk, Hitachi's £61 160GB Deskstar T7K250 is a better option. It has the best file transfer times of all the PATA disks, performing well in both our large and small file tests. At a fair 38p per gigabyte it is the obvious Best Budget Buy.

If you're looking for a large single PATA drive, Seagate's whopping 400GB Barracuda ST3400832A is a great choice. At 46p per gigabyte it's not the cheapest storage, but it is fast – especially when streaming large files. It's

ideal for a Media Center PC (see PC Builder on page 242), where you need a lot of storage in a small case. But if you have plenty of space in your computer and enough spare PATA connectors, you could buy two of the Western Digital drives for £50 less. These could even be configured in a RAID array to address their performance limitations.

If you just want a bit of extra storage space for files and photos without spending a lot, Excelstor's Jupiter 880 Callisto is a fine budget option. At 47p per gigabyte it's not the most economical hard disk, but it's still very affordable at under £40. Despite having only 2MB of cache, it is a decent performer too. As it is also the quietest disk here, the Excelstor would make a good drive for an MP3 jukebox, providing sufficient space for over 1,000 albums. **CS**

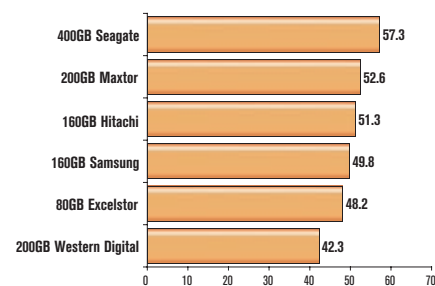
HITACHI Deskstar T7K250



BENCHMARKS

Performance PATA Internal Disks

Large Files Overall (MB/s)



Small Files Overall (MB/s)

